

WHAT IS CLAIMED IS:

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1. A point-to-multipoint optical communications system comprising:
an optical line terminal (OLT); and
a plurality of optical network units (ONUs) connected to said OLT by a
passive optical network in which downstream data is transmitted from said OLT
to said ONUs over said passive optical network and upstream data is transmitted
from said ONUs to said OLT over said passive optical network;
said OLT transmitting downstream data over said passive optical
10 network in variable-length downstream packets;
said ONUs transmitting upstream data over said passive optical
network within ONU-specific time slots utilizing time division multiplexing,
wherein said ONU-specific time slots are filled with multiple variable-length
upstream packets.
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2. The system of claim 1 wherein said variable-length downstream packets are
formatted according to IEEE 802.3.
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3. The system of claim 1 wherein said variable-length downstream packets
include Internet protocol (IP) datagrams.
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4. The system of claim 3 wherein the lengths of said variable-length downstream
packets are related to the lengths of said IP datagrams.
5. The system of claim 1 wherein said variable-length upstream packets are
formatted according to IEEE 802.3.
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6. The system of claim 1 wherein said variable-length upstream packets include
Internet protocol (IP) datagrams.

SUB A² 7. The system of claim 6 wherein the lengths of said variable-length upstream packets are related to the lengths of said IP datagrams.

SUB B¹ 8. The system of claim 1 wherein:
 5 said variable-length downstream packets and said variable-length upstream packets are formatted according to IEEE 802.3, and
 said downstream data and said upstream data include Internet protocol (IP) datagrams.

10 9. The system of claim 1 wherein:
 said OLT includes a fragment buffer for storing packet fragments that have been transmitted upstream from said ONUs; and
 said ONUs include fragment buffers for storing packet fragments that are to be transmitted upstream from said ONUs.

15 10. The system of claim 9 wherein said ONUs include fragment logic for:
 splitting a variable-length upstream packet into first and second packet fragments; and
 adding an end-of-packet-fragment code to said first packet fragment and
 20 adding a start-of-packet-fragment code to said second packet fragment.

25 11. The system of claim 10 wherein said OLT includes fragment logic for:
 identifying said end-of-packet-fragment code of said first packet fragment;
 buffering said first packet fragment in said OLT fragment buffer;
 identifying said start-of-packet-fragment code of said second packet
 fragment; and
 reconstructing said variable-length upstream packet from said first and
 second packet fragments.

SUB A³ 12. A method for exchanging information between an optical line terminal (OLT) and multiple optical network units (ONUs) in a point-to-multipoint passive optical network comprising:

- transmitting downstream data from said OLT to said ONUs in variable-length downstream packets;
- transmitting upstream data from said ONUs to said OLT in ONU-specific time slots utilizing time division multiplexing to avoid transmission collisions, wherein said ONU-specific time slots are filled with variable-length upstream packets.

10 13. The method of claim 12 wherein said variable-length downstream and upstream packets are formatted in accordance with the IEEE 802.3 protocol.

SUB A⁴ 14. The method of claim 12 wherein said variable-length downstream and upstream packets include a header and a payload, and wherein the length of each of said variable-length packets is related to the length of an Internet protocol (IP) datagram that is included in the payload of said variable-length packets.

15 15. The method of claim 12 further including steps of:

inserting downstream Internet protocol (IP) datagrams into said variable-length downstream packets; and

inserting upstream IP datagrams into said variable-length upstream packets.

20 16. The method of claim 15 wherein said variable-length downstream and upstream packets are formatted in accordance with the IEEE 802.3 protocol.

25 17. The method of claim 12 wherein said step of transmitting downstream data includes transmitting downstream synchronization markers at constant time intervals.

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18. The method of claim 12 wherein said ONU-specific time slots are filled with multiple variable-length packets.

Sub 15 5 } 19. The method of claim 12 further including the steps of:
 splitting a variable-length upstream packet into a first packet fragment and a second packet fragment;
 adding an end-of-packet-fragment code to the end of said first packet fragment; and
 10 adding a start-of-packet-fragment code to the start of said second packet fragment.

20. The method of claim 19 further including steps of:
 transmitting said first packet fragment upstream in a first ONU-specific
 15 time slot;
 buffering said second packet fragment for transmission in a second ONU-specific time slot that is different from said first ONU-specific time slot;
 buffering said first packet fragment after said first packet fragment is received at said OLT; and
 20 reconstructing said variable-length upstream packet, at said OLT, from said first packet fragment and said second packet fragment.

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5 21. A point-to-multipoint optical communications system comprising:
 an optical line terminal (OLT); and
 a plurality of optical network units (ONUs) connected to said OLT by a
 passive optical network in which downstream data is transmitted from said OLT
 to said ONUs and upstream data is transmitted from said ONUs to said OLT;
 said OLT including means for formatting downstream datagrams
 into variable-length downstream packets;
 each of said ONUs including:
 means for formatting upstream datagrams into
 variable-length upstream packets; and
 means for timing the transmission of said variable-
 length upstream packets to coincide with ONU-specific time
 slots in order to avoid collisions with upstream packets from
 other ONUs.

10 22. The system of claim 21 wherein said variable-length downstream packets are
 formatted according to IEEE 802.3.

15 23. The system of claim 21 wherein said downstream datagrams are Internet
 protocol (IP) datagrams.

20 24. The system of claim 23 wherein the lengths of said variable-length
 downstream packets are related to the lengths of said IP datagrams.

25 25. The system of claim 21 wherein said variable-length upstream packets are
 formatted according to IEEE 802.3.

30 26. The system of claim 21 wherein said upstream datagrams are Internet
 protocol (IP) datagrams.

Sub A 27. The system of claim 26 wherein the lengths of said variable-length upstream packets are related to the lengths of said IP datagrams.

Sub B 28. The system of claim 21 wherein:

5 said variable-length downstream packets and said variable-length upstream packets are formatted according to IEEE 802.3; and

said downstream datagrams and said upstream datagrams are Internet protocol (IP) datagrams.

10 29. The system of claim 21 wherein:

said OLT includes a fragment buffer for storing packet fragments that have been transmitted upstream from said ONUs; and

said ONUs include fragment buffers for storing packet fragments that are to be transmitted upstream from said ONUs.

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30. The system of claim 29 wherein said ONUs include fragment logic for:

splitting a variable-length upstream packet into first and second packet fragments; and

20 adding an end-of-packet-fragment code to said first packet fragment and adding a start-of-packet-fragment code to said second packet fragment.

31. The system of claim 30 wherein said OLT includes fragment logic for:

identifying said end-of-packet-fragment code of said first packet fragment;

buffering said first packet fragment in said OLT fragment buffer;

25 identifying said start-of-packet-fragment code of said second packet fragment; and

reconstructing said variable-length upstream packet from said first and second packet fragments.